



Warhead: 13.2lb (6kg) of explosive with impact and proximity fuses
Length: 9ft 0in (2.74m)
Body diameter: 6in (0.157m)
Wing span: 1ft 6.5in (0.47m)
Launch weight: 194lb (88kg)
Cruising speed: over Mach 2
Range limits: 985ft-4.35 miles (300m-7km)

Development and Service

This is Matra's answer to the need for a close-range, fast-maneuvring 'dogfight' missile, emphasised by the failure of air-launched missiles to hit MiGs during air combats in Vietnam. Its development was started as a private venture in 1967, but has continued under French Air Force sponsorship since 1969. The R.550 can use the same aircraft launcher as the Sidewinder, which it is intended to replace.

The first air-launch of the missile with guidance

equipment was carried out on 11 January 1972, at Landes Test Centre. Test and evaluation of production missiles began in 1974. Orders have been placed by 12 countries for a total of 5,000 operational and training missiles. The R.550 Magic has been in series production since March 1975 for delivery to customers. By the end of 1978, the 3,200th Magic had been built and production continues at 100 per month.

Magic has been adopted to equip the Mirage III, Mirage 5, Mirage F1 and Crusader, and is at present being adapted for the Jaguar, Super Etendard, Macchi MB326K and Alpha Jet. It will also arm the Delta 2000.

The R550 Magic is stated by its manufacturers to be the only air superiority missile operational at present capable of intercepting and destroying existing fighters even when they are manoeuvring at their maximum g capabilities.

Rapier

Surface-to-air close-range missile. In production and service.

Prime contractor: British Aerospace Dynamics Group

Powered by: IMI two-stage solid-propellant rocket motor

Airframe: Cylindrical body, with cruciform cropped-delta wings mounted mid-way between the pointed conical nose and the cruciform tail-fins

Guidance and Control: Radio command guidance system, along line-of-sight to target. Add-on radar tracking system for all-weather operation also in full production. Control by movable tail surfaces

Warhead: High-explosive, with impact fuse

Length: 7ft 3in (2.2m)

Body diameter: 5in (0.13m)

Wing span: 1ft 3in (0.38m)

Weight: approx 88lb (40kg)

Max speed: over Mach 2

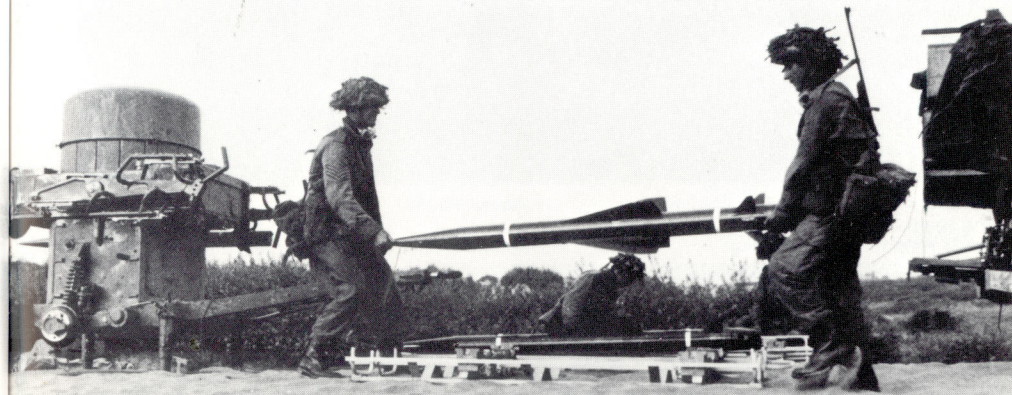
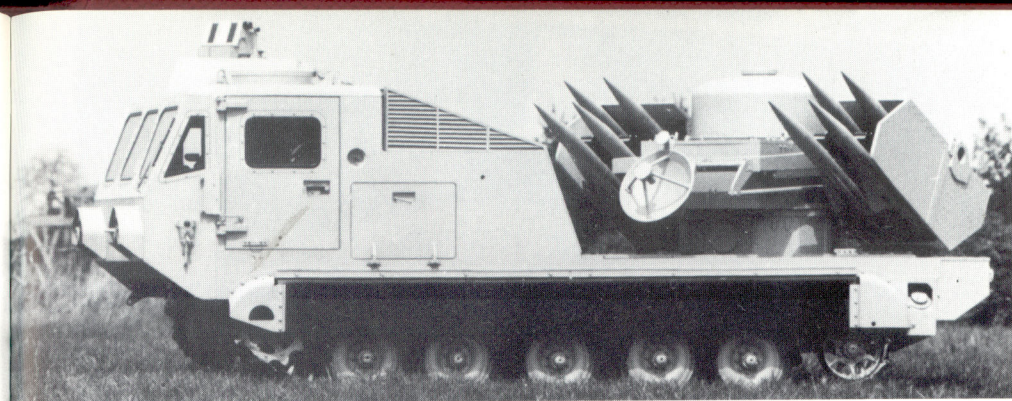
Range: Can operate from ground level up to at least 10,000ft (3,660m)

Development and Service

Known originally as the ET.316 low-level anti-aircraft guided weapon system, Rapier was developed initially under a contract awarded in September 1964. Progress was so rapid that production of the missile for the British Army and RAF Regiment was able to begin by mid-1967. Operational deployment by both services was under way by 1971. Large export orders for Rapier have been received from Australia, Zambia, the Sultanate of Oman and Abu Dhabi.

Rapier is a quick-reaction weapon, designed to achieve a high kill probability when launched against helicopters, subsonic and supersonic fixed-wing aircraft at all heights from ground level to above 3,000m. The system can use either an optical or radar mode of operation. The main system elements are a launcher containing the surveillance radar, an optical tracker and two power units. Once the launcher has been loaded by two members of the three/five-man detachment (seven men for 'blindfire' operations), it can be left unattended and the system

UK



can be operated by one man at the optical tracker. When the surveillance radar in the launcher detects a target, an IFF interrogator determines if it is hostile. If it is, the launcher and tracker are aligned automatically in the direction of the target. In the optical system, the operator acquires the target in elevation and then tracks it by means of a joystick, with the launcher following the tracker as he does so. When the target is within range, as assessed by a computer, the operator is informed and fires a Rapier missile. Flares on the missile are followed by a TV camera in the tracker, which measures deviations from the sightline. The computer uses these data to correct the missile's trajectory and keep it on course to the target.

For operation at night, or in bad visibility, a 'blindfire' radar tracker is used to automatically

Top: Tracked Rapier system.

Above: Loading Rapier missiles on to the four-round launcher.

perform the functions of the optical tracker for target tracking and missile-to-sightline error measurement. The operator remains in control of the engagement, and can choose between an optical or radar-directed engagement up to missile launch.

The launch unit can be towed by a Land-Rover or similar light vehicle, carrying in the back the missiles and optical tracker. If a 'blindfire' tracker is needed, a second vehicle is required. The Rapier system is air transportable.

Latest version is the Tracked Rapier system based on an M-548 or similar vehicle, which was ordered by Iran prior to the change of government.

RB04

Air-to-surface tactical missile. In service

Data: RB04E

Prime contractor: Saab-Scania Aktiebolag

Powered by: IMI solid-propellant rocket motor

Airframe: Body of circular section, tapering in a smooth curve towards nose and tail. Mid-set rear-

mounted wings, each with a trailing-edge aileron and fixed end-plate fin. Cruciform cropped-delta control surfaces at front of missile

Guidance and Control: Philips (Sweden) active-seeker head. Control by ailerons and foreplanes

Warhead: High-explosive type, weighing 660lb (300kg), with proximity fuse

Length: 14ft 8in (4.47m)

Sweden



Max body diameter: 1ft 7.75in (0.50m)
Wing span: 6ft 5.5in (1.97m)
Launch weight: 1,358lb (616kg)
Max speed: High subsonic
Range: over 12.5miles (20km)

Development and Service

This formidable all-weather attack missile was evolved originally by the Swedish Guided Weapons Directorate (Robotavdelningen), to meet a 1949 requirement for an anti-shipping weapon. The first complete RB04 was launched from a Saab J29 fighter on 11 February 1955; four years later the missile became standard armament on the Saab A 32A Lansens which equip attack wings of the Swedish Air Force. Performance is subsonic, but the

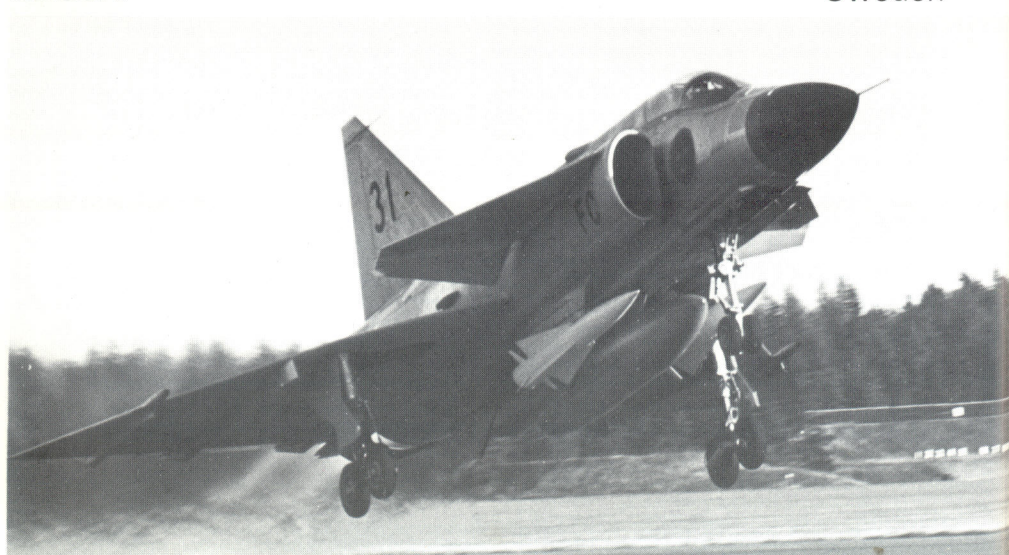
Above: RB04E.

RB04 has proved so effective that it also equips the Saab AJ 37 Viggen Mach 2 attack fighter. This aircraft carries a third RB04 under its fuselage, in addition to the usual two on underwing mountings.

Current version of the missile on the A 32A is the RB04D, with higher performance than the earlier standard RB04C. The 'D' became operational in 1972 and has been followed by the RB04E, with revised structure and guidance to improve reliability and accuracy. Saab-Scania was prime contractor for the RB04E, which is now out of production. It can be launched at between Mach 0.4 and near-sonic speeds. It then flies a preprogrammed descent to low level for attack.

RB05A

Sweden



Tactical air-to-surface missile. In service

Prime contractor: Saab-Scania Aktiebolag

Powered by: Volvo Flygmotor VR-35 storable liquid-propellant rocket motor

Airframe: Cylindrical body with long ogival nose. Long-chord cruciform delta wings, indexed in line with cruciform tail control surfaces

Guidance and Control: Command guidance, via pilot-operated joystick, with aid of tracking flare on missile. Control via tail surfaces

Warhead: High-explosive, with proximity fuse

Length: 11ft 10in (3.60m)

Body diameter: 1ft 0in (0.30m)

Wing span: 2ft 8in (0.80m)

Launch weight: 675lb (305kg)

Max speed: Supersonic

Range: 5.5 miles (9km)

Bottom left: RB05As carried by a Viggen.

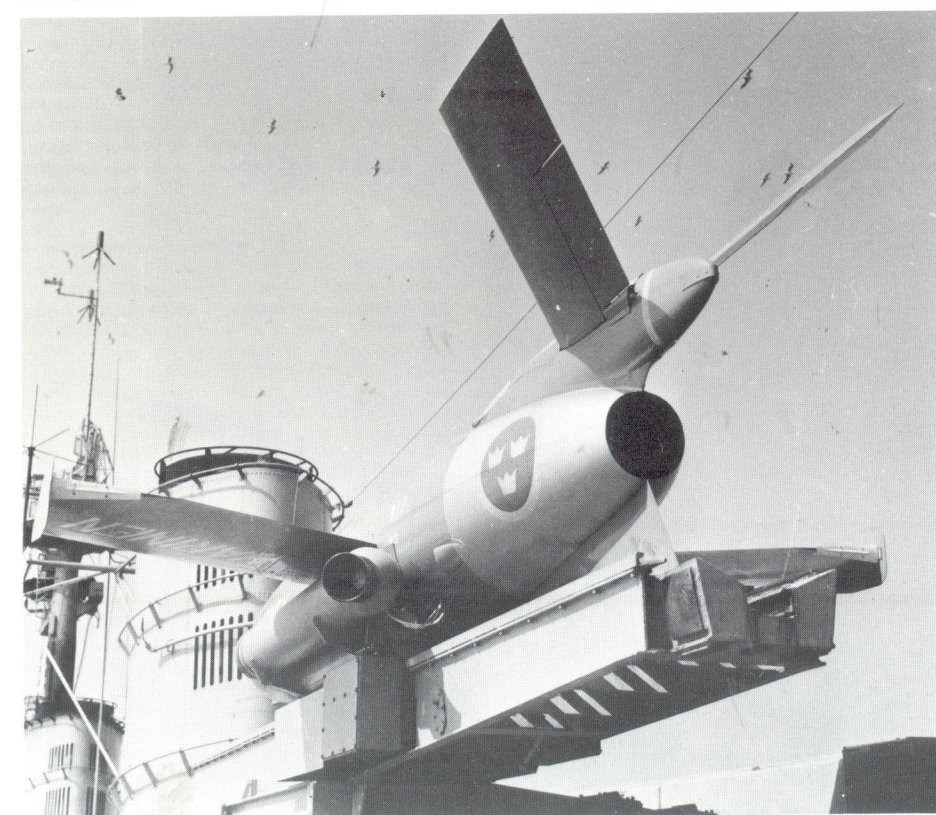
Development and Service

In its initial form, this weapon lacks the all-weather capability of the RB04, being manually-guided. However, the precision of the guidance system and high degree of manoeuvrability of the missile make it possible to attack sea or land targets situated a considerable distance to either side of the launch aircraft's course, and Saab claims that the RB05A can also be used in an air-to-air role. The microwave radio link over which the pilot's command signals are transmitted is said to be highly resistant to jamming and to permit full control of the missile at low altitudes over all kinds of terrain. The pilot simply guides the missile so that a tracking flare on its rear end remains aligned on the target.

Development of the RB05A began in 1960, under the designation Saab 305A. An initial £14.5million production contract was placed in November 1970, to arm the AJ 37 Viggen and the SK 60B/C versions of the lightweight Saab-105 in Swedish Air Force service. However, the missile went out of production in 1978.

RB08A

Sweden



Surface-to-surface or ship-to-ship missile. In service.

Prime contractor: Saab-Scania Aktiebolag
Powered by: Turboméca Marboré IID turbojet. Two solid-propellant booster rockets power the launch carriage
Airframe: Circular-section body which tapers towards nose and tail. Long tapered radome above nose air intake. Mid-set folding wings are swept at 30 degrees and fitted with end-plates and spoilers. Vee-type tailplane and elevators are supplemented by ventral fin, all swept at 30 degrees
Guidance and Control: Autopilot control, following directional firing. Terminal homing. Aerodynamic control by spoilers and elevators
Warhead: High-explosive
Length: 18ft 9.25in (5.72m)
Max body diameter: 2ft 2in (0.66m)
Wing span: 9ft 10.5in (3.01m)
Launch weight: 2,678lb (1,215kg) (inc booster)
Performance: Secret

RB83

Air-to-surface missile. Under development.

Guidance and Control: Infra-red homing

Development and Service

This missile is being developed to arm the Saab B3LA light combat aircraft/jet trainer when it enters service in the 1980s.

RBS 70

RBS 70 launch.



Development and Service

This missile had its origin in the French CT.20 target drone, designed and manufactured by Nord-Aviation. The French company evolved combat versions known as the SM.20 and MM.20 for surface-to-water (so-mer) and water-to-water (mer-mer) use respectively, and stated that these could carry a 550lb (250kg) warhead over a range of 155 miles (250km). The Royal Swedish Navy awarded Saab a contract to develop a similar operational version of the CT.20 in 1959, followed by a production contract in 1965. Deliveries were completed by 1970, and the RB08A is now deployed with coastal defence batteries and on board *Södermanland* and *Halland* classes of destroyers of the Royal Swedish Navy. In the latter case, the missiles are stored below deck and transferred by ramp to the launcher when required for action. The Swedish-designed warhead is claimed to be highly-effective against invasion from the sea.

Sweden

Portable surface-to-air missile system. In production and service.

Prime contractor: AB Bofors
Guidance and Control: Optical beam-rider, via laser beam
Container length: 5ft 3in (1.58m)
Container diameter: 6in (0.15m)
Total weight of firing unit: approx 176lb (80kg)
Missile weight in container: 47.5lb (21.5kg)
Range: 1.8-3.1 miles (3-5km)

Redeye (FIM-43A)

Shoulder-fired surface-to-air missile. In service.

Prime contractor: General Dynamics Corporation, Electro Dynamic Division
Powered by: Atlantic Research Corporation M115 dual-thrust solid-propellant rocket motor
Airframe: Cylindrical body with flip-out cruciform tail-fins and nose vanes. Glass nose over infra-red seeker
Guidance and Control: Initial optical aiming, with infra-red terminal homing. Control via nose vanes
Warhead: High-explosive
Length: 4ft 0in (1.22m)
Body diameter: 2.75in (0.07m)
Launch weight: 18lb (8.2kg)
Weight of complete system: 29lb (13.15kg)
Cruising speed: Supersonic
Range: 11,150ft (3,400m)

Development and Service

After satisfying the US Army as to the feasibility of such a weapon system, the former Convair-Pomona division (later Pomona operation of Electro Dynamic Division of GD) received a contract to develop Redeye in August 1959. Production began in 1964 and eventually reached the rate of more than 1,000 missiles per month for the US Army and Marine Corps. Each armoured, artillery and infantry battalion of the Army has a Redeye section composed of one officer, a sergeant and four to six two-man firing teams. Redeye is also a standard weapon in the Australian, Danish (known as Hamlet), West German (known as FLF-1 and Fliegerfaust), Swedish (designated RB69) Armies. Production was completed in the 1970 fiscal year.

Extremely compact, the weapon system consists simply of a sealed launch-tube, containing the missile, and a self-contained optical sighting/firing package attached to the tube. This makes it easily transportable by one man in a combat area, or in rough country, and it is effective against attacking aircraft at altitudes and ranges commensurate with the defence of Army field positions and Marine Corps amphibious operations. When the operator sights an enemy aircraft, he tracks it by means of the sight and energises the missile guidance system. A buzzer informs him when the missile is ready to fire. The

Development and Service

Development started in 1969 and was completed, after three series of firing tests, in 1974. The RBS 70 system can be used against fighter-bombers and helicopters. Its main characteristics include good resistance to jamming, short reaction time, and ability to engage at coarse angles. The system can utilise precision target location data from a search radar, and IFF equipment can be connected. The firing can be carried out by one man. The system is operational with the Swedish Army and NATO and has been ordered by several other countries.

USA

boost charge propels the missile out of the launcher. When Redeye has travelled far enough to protect the operator from blast effects (about 20ft; 6m), the sustainer fires and propels the missile to the target.



Red Top

Air-to-air missile. In service.

Prime contractor: British Aerospace Dynamics Group

Powered by: Solid-propellant rocket motor

Airframe: Cylindrical body, with fixed cruciform wings indexed in line with cruciform triangular tail control surfaces. Hemispherical glass nose

Guidance and Control: Infra-red homing guidance system. Control by tail surfaces

Warhead: High-explosive, weighing 68lb (31kg)

Length: 10ft 9in (3.27m)

Body diameter: 8.75in (0.222m)

Wing span: 2ft 11.75in (0.91m)

Weight: Secret

Cruising speed: Mach 3

Max range: 7.4 miles (12km)



Development and Service

Red Top was developed originally, as Firestreak Mk IV, to overcome the limitations of the earlier pursuit-course missile. Its much improved infra-red guidance system enables the pilot of the launch aircraft to fire it against the target from any direction, even dead ahead, and the larger wings and tail surfaces offer improved manoeuvrability at all altitudes. Performance is increased by use of a more powerful rocket motor, and the warhead is also heavier than that of Firestreak. Red Top is interchangeable with Firestreak on Lightning interceptors of the RAF.

UK

Roland

Close-range surface-to-air missile. In production and service

Prime contractor: Euromissile (Aérospatiale Division Engins Tactiques/Messerschmitt-Bölkow-Blohm GmbH)

Powered by: Two stage solid-propellant rocket motor

Airframe: Slim cylindrical body with pointed ogival nose. Fixed cruciform foreplanes indexed in line with hinged cruciform delta wings which extend as the missile leaves the launch-tube

Guidance and Control: Radio command guidance by optical aiming/infra-red tracking system. Control by vanes in sustainer motor exhaust

Warhead: High-explosive with proximity fuse

Length: 7ft 10.5in (2.40m)

Body diameter: 6.3in (0.16m)

Wing span: 1ft 7.75in (0.50m)

Launch weight: 139lb (63kg)

Cruising speed: Mach 1.6

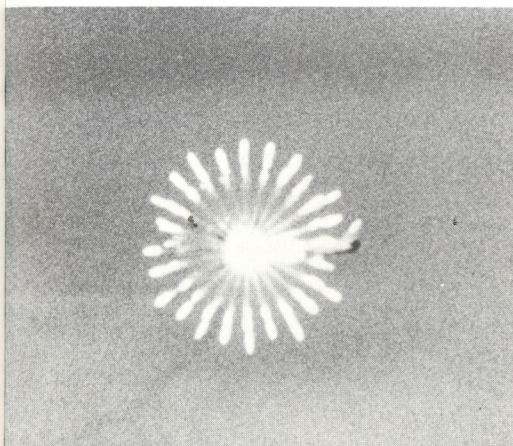
Range limits: 1,650-20,670ft (500-6,300m)

Development and Service

Tube-launched from medium-size armoured vehicles or semi-mobile installations, Roland is intended to provide battlefield defence against helicopters and low-flying fixed-wing aircraft flying at speeds up to Mach 1.3. It is one of a family of tactical missiles developed jointly by Aérospatiale and MBB for the French and German Armies, and firing trials have been underway since 1968. In December 1970 four Rolands were launched against a CT.20 target drone; all achieved successful interceptions and the last one, fitted with a warhead, destroyed it.

In its initial form, as Roland I, the weapon is fired from a twin-launcher, which can be carried with its pulse-Doppler surveillance and search radar on the French AMX-30R and the German SPZ Marder combat vehicles. The missile's shipping container serves also as launcher and is loaded by a hydraulic system which recharges the launch turret each time a missile has been fired. After a target has been located in azimuth by the radar and IFF identification has been performed, the operator acquires it in elevation and tracks it optically. The missile is then

France/Germany



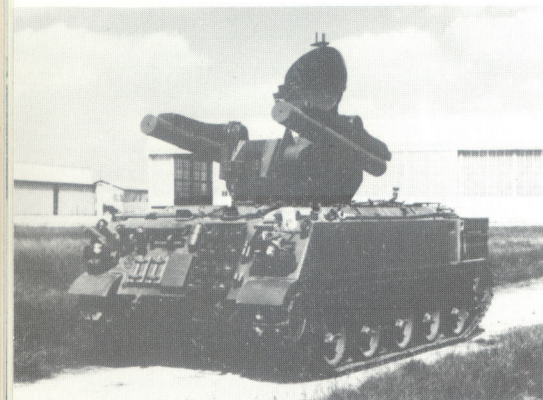
fired. The periscopic sight is linked to an infra-red missile tracking system and a computer, which processes the data fed into it and transmits command signals to the missile to keep it on the line-of-sight course to the target.

Roland II began its development phase in 1968. The French Army originally ordered 12 modified, all-weather Roland II systems. In Roland II it is the tracking radar which searches in elevation and locks on to the target, eliminating the need for an optical tracker. The radar antenna follows the target and carries an infra-red sensor which gathers the missile after launch. A second channel in the radar tracks the missile, to which steering commands are transmitted automatically. Other customers for Roland II include the German Army, US Army, Norwegian Army (32 fire units and 600 missiles) and Brazilian Army. The French Army is expected to receive 96 Roland I fire units and 4,300 missiles and 104 Roland II fire units and 4,450 missiles; the German Army will receive 340 launchers and 12,100 missiles. The US Army missiles will be produced under licence by Hughes

Above: A sequence of photographs showing the first live firing of a US Roland missile against a QF-86 target drone (see p148 for entry on US Roland).

Aircraft Company and will be mounted on the M-109 tracked vehicle (see US Roland).

The first live firing of a production Roland took place in March 1976. The French Army received its initial operational Roland I system in April 1977. Germany received its first operational Roland II in October of the same year.



Above: Roland I on an AMX-30R chassis.



Right: Roland II on an SPZ Marder combat vehicle.

Sabre

UK

Air-to-surface anti-tank missile.
Under development.

Airframe: Based on the Rapier missile
Guidance and Control: Probably laser homing
Launch weight: approx 120lb (55kg)
Cruising speed: over Mach 2
Range: approx 3.1-3.7 miles (5-6km) at low altitude

Development and Service
Sabre is being developed to a British requirement for

an all-weather lightweight anti-tank missile, which could arm several different British and foreign aircraft, including the BAe Hawk advanced training and close support aircraft. Details were first released in 1978. Based on the Rapier surface-to-air missile, Sabre is expected to use a Martin Marietta laser seeker in association with the Pave Spike target designation pod or Thomson-CSF Atlis pod. It is said to be capable of penetrating the latest Soviet T-72 tank, with a likely kill probability of about 80%. It could also have air-to-air capability.

Sagger (AT-3)

USSR



Anti-tank missile. In service.

Powered by: Solid-propellant rocket motor
Airframe: Short cylindrical body, with conical nose. Rear-mounted cruciform wings are swept near body of missile but unswept outboard. Wings fold for storage and transport
Guidance and Control: Wire guidance
Warhead: Hollow charge
Length: 2ft 10in (0.86m)
Body diameter: 5in (0.12m)
Wing span: 1ft 6in (0.46m)
Launch weight: 24.9lb (11.3kg)
Range: 1,640-9,840ft (500-3,000m)

Development and Service

'Sagger' is one of the standard types of small anti-tank missiles serving with the armed forces of Russia, Algeria, Angola, Afghanistan, Ethiopia, Egypt, Iraq, Libya, Syria, Mozambique, Uganda, Vietnam and Yugoslavia. It was first displayed publicly in May 1965. It was shown then on a six-round launcher

mounted on the BRDM-1 armoured amphibious vehicle which is used also as a carrier for 'Snapper' and 'Swatter'. The installation is interesting, as the launcher is protected during transport by an armoured cover plate that encloses it within the vehicle. When the launcher is elevated for action, the cover plate remains in place above the launcher, affording continued protection. A single 'Sagger' is carried on a rail launcher above the 76mm gun on the BMP eight-man armoured personnel carrier, first seen in 1967, and the missile can be carried by the BMD-1 light tank (one launcher), BRDM-2/BTR40PB vehicle (six launchers) and other Warsaw Pact vehicles. 'Sagger' can also be ground-launched by two-man teams, using a portable system.

Salish

USSR

Surface-to-surface cruise missile. In service.

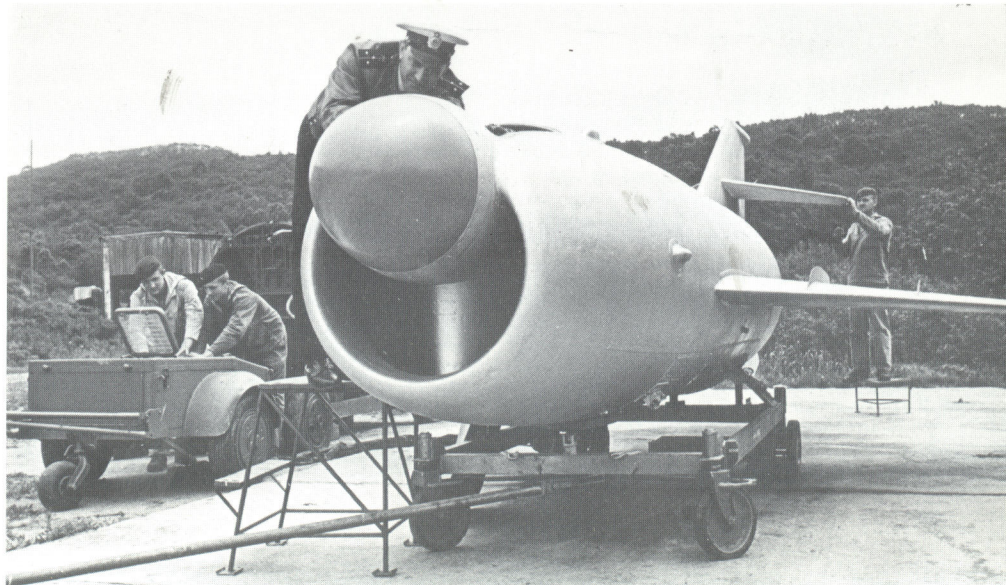
Powered by: Turbojet motor. Also seen with JATO booster
Airframe: Similar to 'Samlet'
Guidance and Control: Probably semi-active homing
Range: approx 62 miles (100km)

Development and Service

Salish is a ramp-launched cruise missile, older in appearance than Samlet. It is thought to carry semi-active homing equipment in its radome, above the nose air-intake. It may have been derived from the air-to-surface 'Kennel'.

Samlet

USSR



Surface-to-surface cruise missile. In service.

Powered by: Turbojet engine. JATO booster used at launching

Airframe: Circular-section metal body, with hemispherical radome above chin-type air-intake at nose. Mid-mounted sweptback wings, each with two fences on top surface. Swept horizontal tail surfaces mounted mid-way up tail-fin

Guidance and Control: Probably beam-riding/command guidance with terminal semi-active radar homing. Aerodynamic control surfaces

SA-N-4

Surface-to-air missile. In service.

Development and Service

Little is known about this close-range weapon system although at least 68 SA-N-4 installations are operational on seven classes of Soviet ships including Sverdlov and Kara class cruisers, Kiev

Warhead: High-explosive

Length: approx 23ft 0in (7.0m)

Wing span: 16ft 0in (4.9m)

Weight: approx 6,615lb (3,000kg)

Cruising speed: approx Mach 0.8

Max range: 63-126 miles (100-200km)

Development and Service

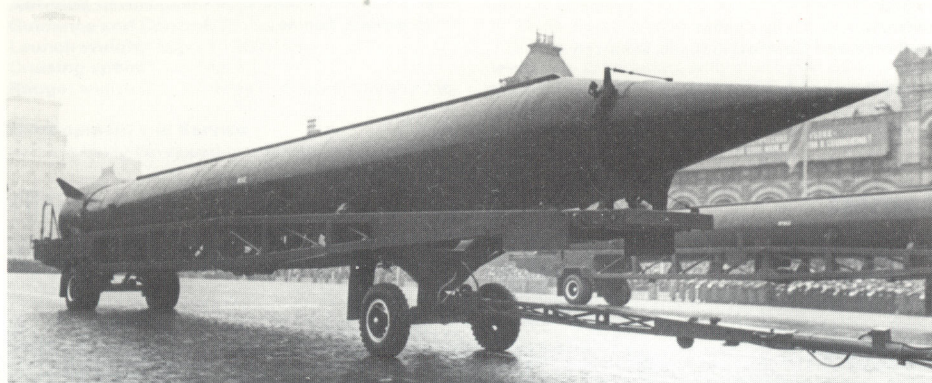
This subsonic cruise missile is a surface-to-surface version of the air-to-surface 'Kennel'. It differs little from the air-launched weapon and is used primarily for coastal defence by the armed forces of the Soviet Union, Poland, Egypt and Cuba.

aircraft carriers, Krivak destroyers, Nanuchka and Grisha corvettes and Koni frigates. The retractable twin-round 'pop-up' launcher is housed inside a bin on the deck. The missiles are thought to be the same as those used in the land-mobile 'Gecko' (SA-8) system. The fire control radar system carries the NATO reporting name 'Pop Group'.

USSR

Sandal (SS-4)

USSR



Surface-to-surface medium-range ballistic missile. In service.

Powered by: One liquid-propellant engine. No booster

Airframe: Cylindrical metal body, with flared skirt around nozzle and small cruciform tail-fins. Pointed conical nose-cone

Guidance and Control: Inertial guidance system. Control by elevators in trailing-edges of tail-fins and vanes operating in rocket efflux

Warhead: Alternative nuclear (one MT) or high-explosive

Length: 68ft 0in (20.8m)

Max body diameter: 5ft 3in (1.60m)

Launch weight: approx 60,000lb (27,200kg)

Max speed: 4,300mph (6,900km/h)

Max range: approx 1,100 miles (1,750km)

Development and Service

After early postwar firing trials with captured German V-2 bombardment rockets, the Soviet Union evolved an improved version which became known to NATO forces as the SS-3 'Shyster'. This had a longer, cylindrical body, permitting increased propellant tankage, and was first displayed in a Moscow parade in November 1957. Its transporter was hauled by a tracked vehicle carrying the launch crew.

In 1961, a further-improved version was shown for the first time. Known in the west as the SS-4 'Sandal', this is longer, giving increased propellant capacity and range. 'Sandal' was first deployed in 1959. It can be identified by the flared skirt over its rocket nozzle, and smaller tail-fins. 'Sandal's' transporter is hauled by the same kind of vehicle as that of 'Shyster', the complete missile system being completed by other tractor/trailer units carrying ground support equipment and propellants.

'Sandal' replaced 'Shyster' as Russia's standard

MRBM and has been used widely, in modified forms, as a satellite launch vehicle. Between 400 and 450 are thought to remain operational, of which a reasonable number are directed at China and Japan and the remainder at targets in Western Europe. Discovery by US reconnaissance aircraft of an attempted deployment of 'Sandals' in Cuba led to the Soviet/American confrontation in 1962 and eventual withdrawal of the missiles. 'Sandals' are being replaced by SS-20s with MIRVed warheads (qv).

Savage (SS-13)

USSR

Intercontinental ballistic missile. In service.

Powered by: Three solid-propellant stages, each with four nozzles

Airframe: Three-stage missile, with truss structure between stages. Each stage is cylindrical, of progressively-reduced diameter, with a flared skirt over its nozzles. Pointed conical nose-cone

Guidance and Control: Probably inertial. Control by movable nozzles.

Warhead: Single warhead of one megaton yield or possibly three MRVs

Length: 66ft 0in (20.0m)

Body diameter (excluding skirt):

1st stage 5ft 6in (1.68m)

2nd stage 4ft 7.5in (1.40m)

3rd stage 3ft 2.5in (0.98m)

Launch weight: approx 77,160lb (35,000kg)

Max range: 5,000 miles (8,000km)

Development and Service

This Russian counterpart of Minuteman was first displayed in a Moscow military parade celebrating the 20th anniversary of the end of World War II in Europe, on 9 May 1965.

Two SS-13s tracked by America in November 1970 each delivered a single inert warhead over a range of about 4,500 miles (7,250km).

About 60 SS-13s were deployed. In addition, the top two stages of 'Savage' are used without the first stage in the 'Scamp/Scapegoat' mobile missile system. The SS-13s are expected to be replaced by SS-16s.



Sawfly (SS-N-6)

USSR

Underwater-to-surface or surface-to-surface missile. In service.

Powered by: Liquid-propellant motors, with four first-stage nozzles

Airframe: Probably two-stage missile. Cylindrical body of constant diameter and blunt, tapered nose-cone. No fins or wings

Guidance and Control: Inertially guided

Warhead: Megaton range. Mod 1 and 2 have a single warhead. Mod 3 has two or three MRVs

Length: 42ft 0in (12.8m)

Max body diameter: 5ft 9in (1.75m)

Range: Mod 1 1,500 miles (2,415km)

Mod 2/3 1,840 miles (2,960km)

Development and Service

'Sawfly' is considerably larger than the US Navy's Poseidon, but is estimated to have a shorter range.



However, its numbers provide the Soviet Navy with a formidable attack capability against soft targets. The Mod 1 became operational in 1968, followed later by Mod 2 and 3, and a total of 34 'Yankee' class nuclear-powered submarines, each with 16 SS-N-6 tubes, had been launched by mid-1978. The original Mod 1 version has been replaced progressively by the longer-range Mod 2 since 1974. A Mod 3 MRV version of the SS-N-6 is also operational and may replace or have replaced Mod 2s. It has been reported that total 'Sawfly' production amounted to about 1,000 missiles. A newer and more formidable missile has been developed as a 'Sawfly' replacement.

SA-X-10

USSR

Surface-to-air missile. Under development.

Powered by: Single stage solid-propellant rocket motor

Guidance and Control: Active radar terminal homing

Length: approx 23ft 0in (7.0m)

Body diameter: approx 1ft 6in (0.46m)

Max speed: approx Mach 6

Range: approx 31 miles (50km)

Ceiling: approx 16,400ft (5,000m)

Development and Service

The SA-X-10 is under development in the Soviet Union as a strategic surface-to-air missile capable of destroying cruise missiles. It is reported to have a very high rate of acceleration and is associated with continuous wave tracking radars. Flight testing may have begun already.

Scaleboard (SS-12)

USSR



Surface-to-surface tactical missile. In service.

Powered by: Storable liquid-propellant rocket motor

Airframe: Cylindrical body, with tapered nose-cone and either tail-fins or vernier engines at base

Guidance and Control: Probably inertial guidance, set up before missile launch by means of equipment situated between two inner wheels on port side of transporter

Warhead: Probably thermonuclear in megaton range

Length: 37ft 0in (11.25m)

Body diameter: estimated at over 3ft 3in (1.00m)

Max range: 500 miles (805km)

Development and Service

First seen in November 1967, this mobile ballistic missile is about the same length as 'Scud-B' and is transported on a similar MAZ-543 eight-wheeled erector-launcher. It is, however, of larger diameter than the 'Scuds', implying a longer range, and differs in being enclosed in a ribbed casing which is elevated with it into the firing position. No photographs have yet shown the missile without this casing. During transit, the driver of the vehicle occupies the left-hand cab at the front, with the launch operator and his control console in the right-hand cab and seats for at least three other members of the launch crew to the rear of these cabs. A 'Scaleboard' replacement has already appeared in the form of the SS-22.

Scamp/Scapegoat (SS-14)

USSR

Mobile surface-to-surface ballistic missile system. In service.

Data: 'Scapegoat'

Powered by: Solid-propellant motors, with four nozzles on each stage

Airframe: Two-stage missile, with truss structure between stages. Each stage is cylindrical with a flare skirt over its nozzles. Second stage has smaller diameter than first, and is fitted with a pointed conical nose-cone

Guidance and Control: Probably inertial

Warhead: Nuclear, approx 1 MT

Length: 35ft 0in (10.6m)

Body diameter (excluding skirt):

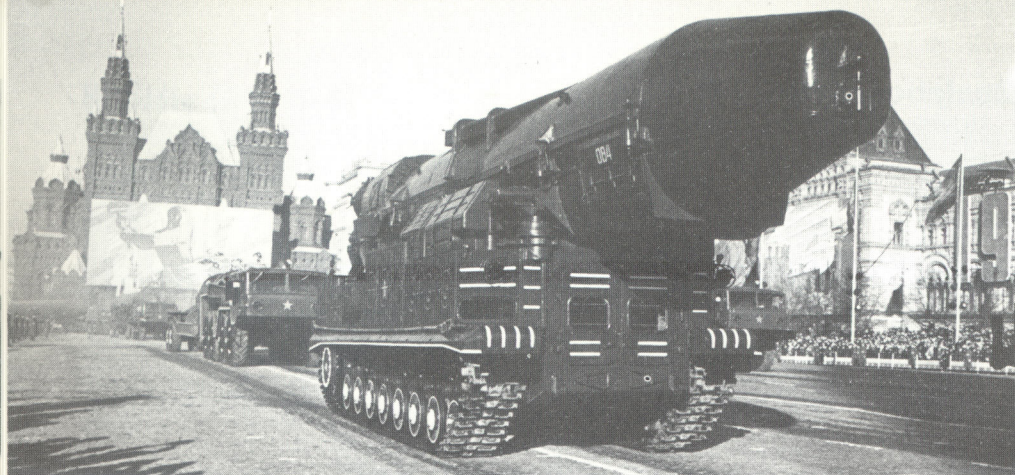
First stage 4ft 7.5in (1.40m)

Second stage 3ft 2.5in (0.98m)

Max range: 2,500 miles (4,000km)



Right: 'Scapegoat' missiles in firing position.



Development and Service

First included in a Moscow parade to mark the 20th anniversary of the end of World War II, on 9 May 1965, this tracked weapon system was nicknamed 'Iron Maiden' by Western observers. This reflected the fact that the missile is enclosed in a container which is made in two halves, split horizontally and hinged. For firing, a massive hydraulic jack on each side of the vehicle, at the rear, raises the container to a vertical position. The container is then opened and moved away from the missile before the latter is launched.

For several years the configuration of the missile carried by the tracked erector/launcher was not known; the complete weapon system was therefore

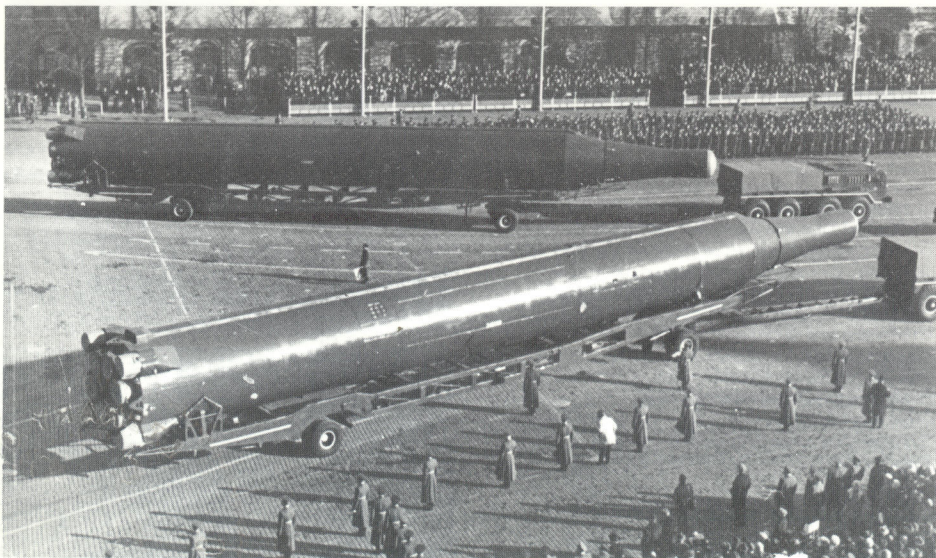
Above: 'Scamp/Scapegoat' system.

given the NATO code-name 'Scamp'. The separate code-name 'Scapegoat' was given to a two-stage IRBM first displayed on a trailer in 1967, which appeared to consist of the top two stages of the ICBM known as 'Savage'. Not until later did official Soviet films of missile exercises reveal 'Scapegoat' to be the missile carried inside the 'Scamp' container. The original type of tracked vehicle has been superseded by an improved model, similar to that used in the 'Scrooge' weapon system. Like the latter, 'Scamp/Scapegoat' has been reported in operational service in Outer Mongolia, adjacent to the Chinese frontier.

P.F. 866077

Scarp (SS-9/FOBS)

USSR



Intercontinental ballistic missile, and fractional orbital bombardment system. In service.

Powered by: Liquid-propellant rocket motors. Ring of six first-stage nozzles is surrounded by four equispaced vernier nozzles

Airframe: Three-stage missile. Cylindrical body of constant diameter, which tapers near the top to blend with cylindrical re-entry vehicle of much smaller diameter. Wedge-shaped fairings over vernier nozzles at tail. No fins or wings

Guidance and Control: Inertial

Warhead: Four alternative warheads have been tested: a single 20- or 25-megaton charge; an unguided MRV comprising three separate re-entry vehicles each with a yield of 4-5 megatons; and the FOBS 'space-bomb'. A MIRV warhead was under development

Length: 121ft 5in (37m)

Body diameter: 10ft 0in (3.05m)

Launch weight: approx 440,925lb (200,000kg)

Max range: 7,500 miles (12,070km)

Development and Service

When first revealed, 'Scarp' was the most formidable weapon in the world, with a thermonuclear warhead of 20/25-megaton yield. This throw weight may have been doubled in the new Soviet SS-18. It was first deployed in 1965 and first exhibited in the Moscow parade of 7 November 1967, marking the 50th anniversary of the Communist Revolution. Four days earlier, the American Secretary of Defense had announced the existence of a Soviet 'space bomb'

which was first tested, in the guise of the Cosmos 139 satellite, on 25 January 1967. During many subsequent tests, inert 'space bomb' payloads were sighted optically from the Royal Aircraft Establishment at Farnborough, and are estimated to be about 6ft 6in (2.0m) long and 4ft (1.2m) in diameter. The 'space bomb' version of 'Scarp' is known in America as a fractional orbital bombardment system (FOBS). This reflects the fact that the rocket puts its thermonuclear payload into an orbit about 100 miles (160km) above the Earth. At a pre-determined point, before completion of the first orbit, the payload is intended to be slowed by retro-rockets so that it will drop precisely on to its target. It is not thought that FOBSs are deployed at any of the regular SS-9 sites.

As an alternative to its single very large warhead, the standard SS-9 ICBM can carry a simple, unguided multiple re-entry vehicle (MRV) made up of three separate smaller charges. During one test in 1970, observed by US reconnaissance satellites and naval vessels, an MRV travelled about 5,500 miles (8,800km) and re-entered the atmosphere with its three inert warheads dispersing to impact 80 miles (130km) apart — about the same distance that separates a cluster of three typical US Minuteman ICBM silo launchers. There is also reason to believe that 'Scarp' can be used as a depressed trajectory missile and has been used as launcher for the Cosmos satellites which have intercepted and destroyed other test satellites in orbit. 288 'Scarp' ICBMs were emplaced in the Soviet Union. All are 'hot launched'. Replacement with SS-18s began a few years ago.

Scrooge (SS-XZ)

USSR

Mobile strategic weapon system. In service.

Powered by: Solid-propellant rocket motors

Warhead: Thermonuclear or nuclear

Length of launch-tube: 62ft 0in (18.90m)

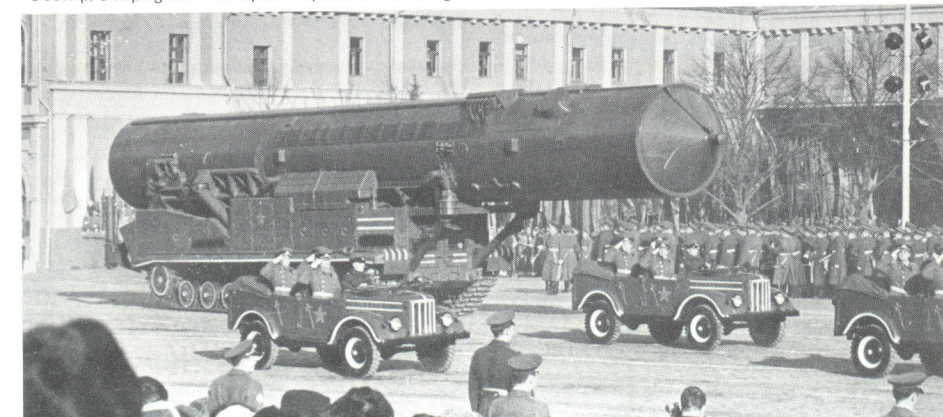
Diameter of launch-tube: 6ft 6in (2.00m)

Max range: 3,500 miles (5,600km)

Development and Service

Despite an obvious similarity in concept to the 'Scamp/Scapegoat' weapon system, 'Scrooge'

remains one of the Soviet Union's lesser-known strategic missiles. The container, housing the missile, is raised vertically for firing, but does not hinge open and is used as a launch-tube. Its length suggests that the missile is much longer than 'Scapegoat' and would therefore have a greater range. It has been suggested that the missile is a modified SS-13 with a less powerful first stage. However, the SS-16 is another possibility. Otherwise little is known about 'Scrooge' except that it has been observed in first-line service on the frontier between Outer Mongolia and China.



Scud-B (SS-1c) and Scud-C

Surface-to-surface missile. In service.

Powered by: Storable liquid-propellant rocket motor

Airframe: Cylindrical single-stage metal structure, with movable cruciform tail-fins and pointed nose-cone

Guidance and Control: Simplified inertial guidance system; possibly limited radio command during flight. Control by vanes in rocket motor efflux

Warhead: Optional nuclear or high-explosive

Length: 37ft 0in (11.25m)

Body diameter: 2ft 9.5in (0.85m)

Launch weight: approx 13,890lb (6,300kg)

Range: 174 miles (280km)

Development and Service

Enlarged to provide increased propellant tankage, and hence longer range, this improved 'Scud' first

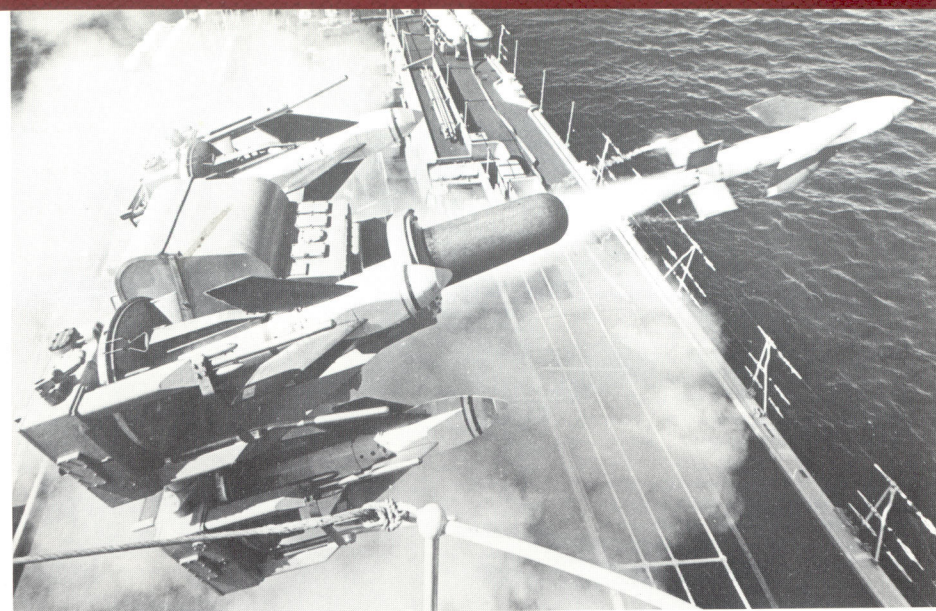
appeared on the same tracked vehicle as 'Scud-A'. It was then seen, in November 1965, on the MAZ-543 eight-wheeled transporter/erector/launch vehicle, which has since become standard. It is supported on a similar cradle to that formerly used for 'Scud-A', which is thought to be no longer in first-line service, with integral ladders at the sides. The launch vehicle is reloadable. Other vehicles that form a 'Scud' battery include a meteorological unit, a tanker vehicle, command/control vehicles, reload and crane loading vehicles.

'Scud-B's' are operated by the forces of Bulgaria, Czechoslovakia, Egypt, East Germany, Hungary, Iraq, Libya, Poland, Romania, Syria and the USSR. Reports have been made of a larger 'Scud-C' missile, with a range of 280 miles (450km).

Below: 'Scud-B'.



USSR



Above: Seacat launch from the New Zealand frigate HMNZS Taranaki.

Within four years sea trials were underway from HMS Decoy. Today, in addition to the Royal Navy, a total of 15 other nations deploy this small and highly-maneuvrable close-range weapon system on their naval craft. Production continues and Seacat is expected to remain in service well into the 1990s.

Simplest of many different fire control systems in service is the Mk 20, in which the standard four-round launcher is controlled by two men in a director unit. One rotates the director so that the second (the aimer) can pick up and track the target through binoculars. The launcher is 'slaved' to the director in azimuth and elevation, with the result that missiles enter the aimer's field of vision soon after launch. The aimer guides each missile to the target by means of a small joystick, using flares on the missile as a tracking reference. The Mk 21 and 22 radar systems provide auto-follow of the target, permitting

both visual and 'dark' firings, and successful trials have been completed for a system which replaces optical sighting with closed-circuit TV. Sweden and Chile use a Dutch M4/3 radar system; Argentina uses an Italian system. Brazil and Iran utilise a new lightweight Seacat system, with a three-round launcher, which can be accommodated in vessels as small as fast patrol boats and minesweepers. The lightweight launcher, with all its ancillaries, weighs only 4,425lb (2,007kg) as compared with the 10,360lb (4,700kg) of the standard four-round Mark 20 launcher. Seacat missiles can now be fitted either as new or as a retro-active modification with the height control device for surface-to-surface application.

Seacat (Swedish Navy designation RB07)

Surface-to-air and surface-to-surface ship-based close-range missile. In production and service.

Prime contractor: Short Brothers Ltd

Powered by: IMI two-stage solid-propellant rocket motor

Airframe: Basically-cylindrical body, changing to wider and more square cross-section on forward portion and with a pointed ogival nose. Pivoted cruciform sweptback wings, indexed at 45 degrees to fixed cruciform tail-fins, two of which carry tip-mounted tracking flares

Guidance and Control: Radio command, with visual or radar tracking. Control by pivoted wings

Warhead: High-explosive, with contact and proximity fuses

Length: 4ft 10.3in (1.48m)

Max body diameter: 7.5in (0.19m)

Wing span: 2ft 1.6in (0.64m)

Weight: approx 140lb (63kg)

Max range: estimated at over 2.95 miles (4.75km)

Development and Service

Seacat has proved one of the most widely-exported guided weapons in the world. Its development started under a contract awarded in April 1958.

UK

Sea Dart (CF.299)

Ship-based surface-to-air and surface-to-surface missile. In production and service.

Prime contractor: British Aerospace Dynamics Group

Powered by: Rolls-Royce Odin ramjet and tandem jettisonable IMI solid-propellant rocket booster. Between-stage vents enable the Odin to be started prior to staging.

Airframe: Missile has cylindrical body with four interferometer arials around nose intake for ramjet. Rear-mounted long-chord cruciform wings indexed in line with cruciform tail control surfaces. Larger-diameter cylindrical booster has cruciform fins that fold forward while the missile is on its launcher

Guidance and Control: Marconi semi-active radar

homing guidance. Control by tail surfaces.

Warhead: High-explosive, with EMI proximity fuse

Length: 14ft 3.5in (4.36m)

Body diameter: 1ft 4.5in (0.42m)

Span: 2ft 11.75in (0.91m)

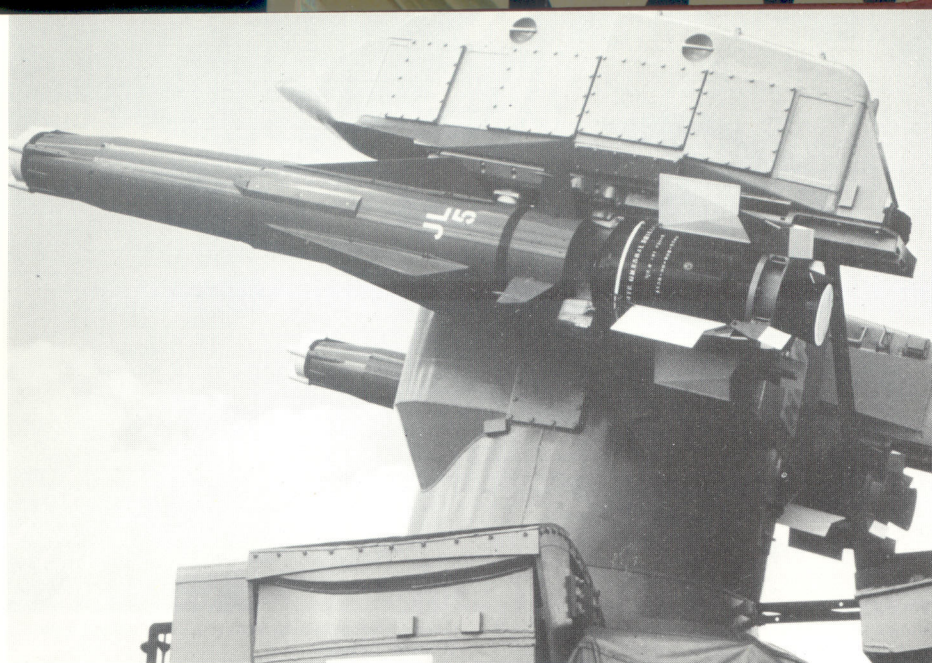
Launch weight: 1,210lb (550kg)

Range: at least 19 miles (30km)

Development and Service

Development of Sea Dart (originally CF.299) was started in 1962, to provide a weapon that would represent a major improvement on Seaslug and yet be compact enough to install on ships smaller than those fitted with the earlier missile. Choice of a ramjet sustainer has made Sea Dart a genuine area-defence weapon, capable of intercepting aircraft and air-launched or surface-launched missiles at both very high and extremely low

UK



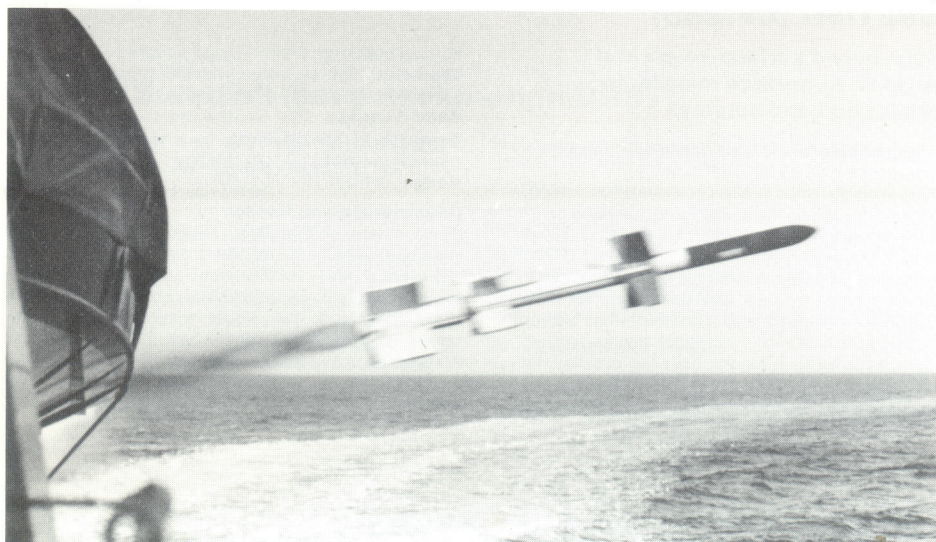
altitudes, with added effectiveness against surface targets. Firing trials began in 1965, confirming that the weapon system offered a rapid launch-rate and the capability of dealing with many targets simultaneously. Production was initiated in 1967 and the first ship to be fitted with the Sea Dart system was the guided missile destroyer HMS *Bristol*, which has a twin-launcher. A similar launcher has been fitted on each of the Type 42 destroyers of the Sheffield class and on two further ships of this class for the Argentine Navy, in addition to ARA *Hercules* of the Argentine Navy. It will also provide area defence for the Royal Navy's new Invincible class of anti-submarine command cruisers. The Sea

Above: Sea Dart missile launcher on board HMS *Bristol*.

Dart system utilises a surveillance radar, two Marconi Type 909 tracking/illuminating radars, a Vickers twin-launcher and handling system, a Ferranti computer for target selection and data handling, a Sperry Gyroscope missile control system and Plessey Radar operations room display equipment.

A Mk2 version of Sea Dart is currently under development. It will incorporate a new rocket booster with thrust-vector control and miniaturised electronics.

Sea Killer Mk 2



Italy

Surface-to-surface ship-launched missile. In service.

Prime contractor: Sistel-Sistemi Elettronici SpA
Powered by: SEP 299 solid-propellant booster, rated at 9,702lb (4,400kg) st for 1.6 seconds, and SEP 300 solid-propellant sustainer, rated at 220lb (100kg) st for 73 seconds

Airframe: Cylindrical light alloy body, with ogival nose-cone. Pivoted cruciform wings of rectangular shape mounted mid-way back on second stage and indexed in line with cruciform tail-fins. Tandem booster with large rectangular cruciform fins indexed in line with second-stage surfaces

Guidance and Control: Guidance by beam-riding/radio command, in conjunction with radar altimeter. Control by movable wings

Warhead: High-explosive, semi armour-piercing, with impact/proximity fuse. Weight 154lb (70kg)

Length: 15ft 5in (4.70m)

Body diameter: 8.1in (0.206m)

Wing span: 3ft 3.5in (0.999m)

Launch weight: 660lb (300kg)

Cruising speed: Mach 0.74

Max range: over 15.5 miles (25km)

Cruising height: Programmed down to 6ft 6in (2.00m)

Development and Service

This Mk2 version of Sea Killer (known for a time as Vulcano) is a two-stage missile, with tandem booster, enabling it to carry a heavier warhead and giving a greatly increased range, at a high subsonic cruising speed. Flight trials started in mid-1969, followed by the first weapon system qualification trials in mid-1971. Limited weight, size and cost suit Sea Killer Mk2 for installation on craft ranging from fast patrol boats to destroyers and frigates, and it is operational on frigates of the Iranian Navy. It can be integrated in ships armed with conventional weapons, fire control radars and systems. If this equipment is not already installed, integration requires the addition of a radar transmitting system, computer, missile control console and closed-circuit television. Sea Killer Mk2 is compatible with the same Contraves shipboard systems as the now obsolete Mk 1 version. It is used in the Marte air-to-surface and Mariner surface-to-surface anti-ship weapon systems.

Sea Skua (CL834)

Air-launched anti-ship missile. Under development.

Prime contractor: British Aerospace Dynamics Group

Powered by: Two-stage solid-propellant boost and sustainer rocket motor

Airframe: Two-diameter cylindrical body, joined one-third-way along length by tapered section. Cruciform foreplane control surfaces, indexed at 45 degrees to cruciform tail-fins

Guidance and Control: Semi-active radar homing head. Radio-altimeter to maintain low cruising height. Control via movable control surfaces

Warhead: 44lb (20kg) weight

Length: 9ft 3.5in (2.83m)

Body diameter: 10.5in (0.27m)

Foreplane span: 1ft 11.5in (0.60m)

Launch weight: 325lb (147kg)

Max speed: High subsonic

Max range: approx 8.7 miles (14km)

Development and Service

Designed specifically for the Fleet Air Arm, Sea Skua

UK

is a lightweight all-weather 'sea skimming' missile which will be carried by frigate-borne Lynx helicopters to provide long-range defence for such ships against missile-armed fast patrol boats, hydrofoils and hovercraft. It will also be capable of inflicting heavy damage on frigates and larger vessels. Four missiles will be carried by each helicopter.

The complete system based on the Sea Skua missile will allow targets to be located, identified and engaged over the horizon from the carrier frigate. The Lynx helicopter will have a Ferranti Seaspray radar for target acquisition and illumination. No on board maintenance or testing is required.

BAC began the first phase of missile development in 1972. Project definition was complete by the autumn of 1975, when government approval for full development was announced. Sea Skua will enter service in the early 1980s. It can also be fitted to other helicopters and fixed-wing maritime patrol aircraft.

Below: Sea Skua missiles carried by a Royal Navy Lynx HAS Mk 2.



Seaslug

Surface-to-air and surface-to-surface ship-launched missile. In service.

Prime contractor: British Aerospace Dynamics Group

Powered by: ICI solid-propellant rocket motor. Four jettisonable solid-propellant wrap-round boosters

Airframe: Cylindrical light alloy body with pointed nose-cone. Cruciform wings mid-way back on body, indexed in line with cruciform pivoted tail control surfaces. Flat-nose boosters extend forward from wings to nose of missile

Guidance and Control: General Electric beam-riding guidance system, utilising Type 901M shipboard radar. Control via movable tail surfaces

Warhead: High-explosive, with proximity fuse

Length: Mk 1 19ft 8in (6.00m)

Mk 2 20ft 0in (6.10m)

Body diameter: 1ft 4.1in (0.41m)

Wing span: 4ft 8.6in (1.44m)

Range: Mk 1 28 miles (45km)

Mk 2 36 miles (58km)

Effective height: over 9.3 miles (15km)

Development and Service

Although virtually obsolete as a long-range anti-aircraft missile, Seaslug is still installed on twin launchers in each of the seven destroyers of the Royal Navy's County class. Three of these ships have the Mk 1 version of Seaslug, which achieved a 90% success rate in launchings against fast target drones at both high and low altitudes during its development testing in the latter 1950s. The Seaslug Mk 2, in the last four ships, offers longer range, improved performance against low-level



Above: Seaslug launch at sea.

targets, and improved surface-to-surface capability.

In operation the launcher is automatically loaded. When a target is located, the system automatically tracks it and points the launcher. When the target is within range the missile is launched. For long-range surveillance, a Type 965 radar is used. For height locating, a Type 227 radar is used, and for missile tracking and illuminating a Type 901 radar.

UK

Sea Sparrow (RIM-7H)

Ship-launched surface-to-air and surface-to-surface close-range missile. In production and service.

Prime contractor: Raytheon Company

Airframe: Cylindrical body with pointed ogival nose. Folding cruciform wings to reduce size of its launcher, and cruciform tail surfaces

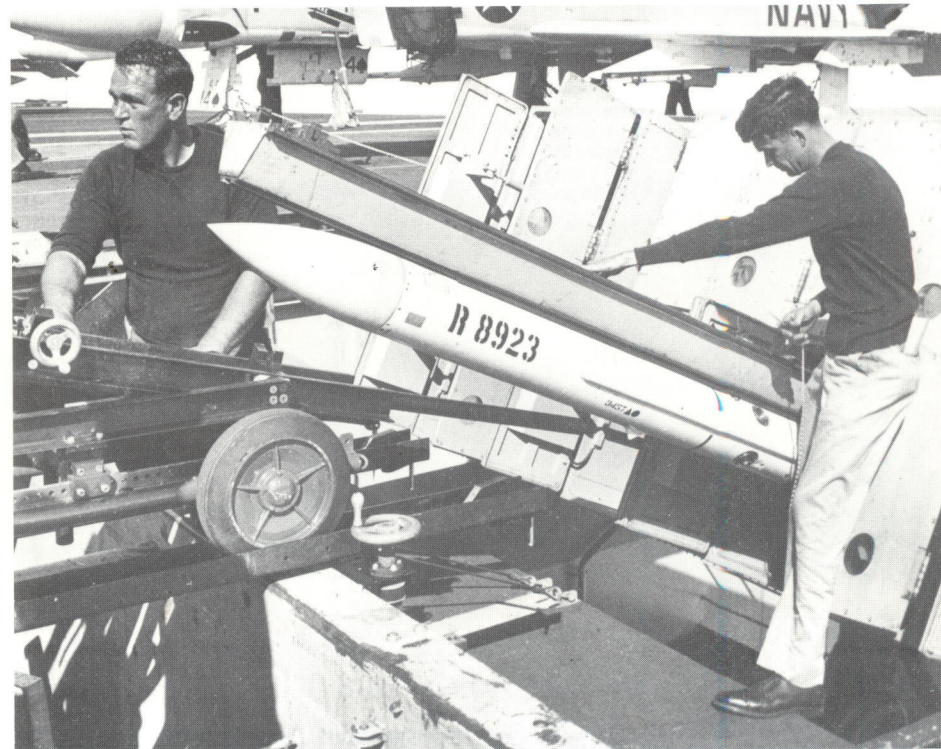
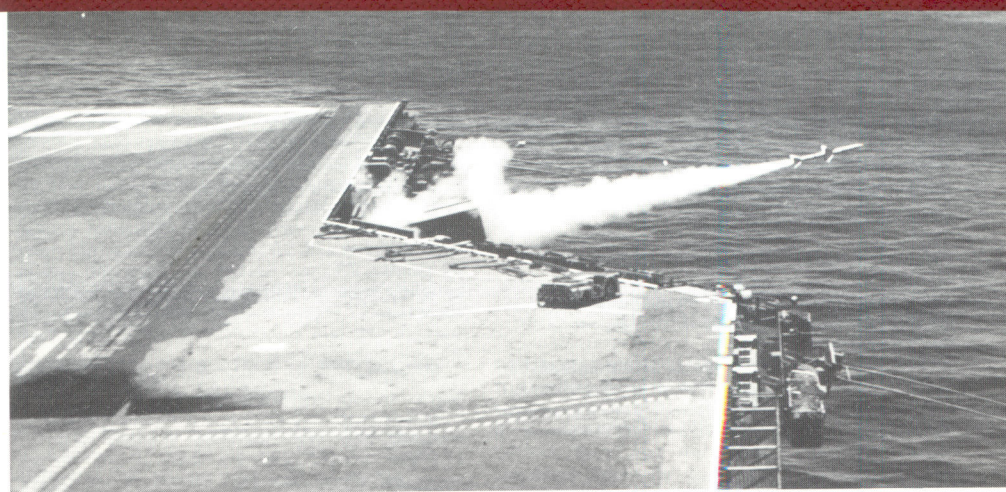
Development and Service

Work on Sea Sparrow began in 1964, under the US Navy designation Basic Point Defence Missile System (BPDMS), to provide protection against enemy aircraft and cruise missiles for ships lacking other missile systems. To save time, the Basic version utilised standard AIM-7E Sparrow III missiles in a modified eight-round Asroc launcher (AIM-7F version subsequently became available). The complete system is mounted on a modified automatic gun carriage and weighs 39,000lb (17,690kg). The Sparrow's CW semi-active radar homing system is unchanged. Shipboard equipment

includes a Mk 51 director/illuminator to acquire and illuminate the target, the manually-operated Mk 115 fire control system being supplied with the necessary target data from the ship's combat information centre. First ships to be fitted with the BPDMS were US Navy attack carriers. Altogether approximately 74 US ships carry the system; 16 missiles were ordered in 1975 for installation on Japanese frigates and several Spanish (and possibly Venezuelan vessels) will carry Sea Sparrow.

An Improved PDMS, known as NATO Sea Sparrow Missile System (NSSMS), was developed by Raytheon in partnership with companies in Belgium, Denmark, Germany, Italy, the Netherlands and Norway under an agreement signed by all but two of these countries in 1968. This retains the Sparrow missile in conjunction with a new lightweight eight-round launcher, a fire control system based on digital computers, a target acquisition system and a powered director/illuminator. In March 1972 the first shipborne launch took place. US Navy technical and

USA



operational evaluation was completed during 1974 on board USS *Downes*, and was followed by evaluation on board the Royal Norwegian Navy destroyer KNM *Bergen* in far-northern environment conditions. Orders for the system were then made for the navies of all participating countries. By adding a Hughes target acquisition system (TAS), NSSMS can be improved to detect automatically cruise missiles flying at low altitude at a range of more than 23 miles (37km) and aircraft at 100 miles (161km).

A Canadian Sea Sparrow missile system, known

Top: Sea Sparrow launched from USS *John F. Kennedy*.

Above: Sea Sparrow launcher on board USS *Enterprise*.

as the Close Range Missile System, has also been developed, and is installed in four destroyers of the Canadian Armed Forces. All ship-launched Sparrow systems can be used in a surface-to-surface role.

Seawolf

Close-range surface-to-air and surface-to-surface missile. In production and service.

Prime contractor: British Aerospace Dynamics Group

Airframe: Cylindrical body with pointed nose. Cruciform delta wings and cruciform tail control surfaces indexed in line

Guidance and Control: Radar guidance normal. TV tracking for low angle or surface-to-surface attack. Control via movable tail surfaces

Warhead: High-explosive, with proximity and contact fusing

Length: 6ft 7in (2.0m)

Wing span: 2ft 3.5in (0.70m)

Launch weight: 176.4lb (80kg)

Max speed: Supersonic

Development and Service

BAC received a contract in June 1967 to develop an advanced surface-to-air weapon system which was then designated PX430 and is now known as Seawolf. Intended as a follow-on to Seacat (qv) it is an all-weather system, giving greatly improved defence capability against supersonic anti-shipping

missiles and aircraft, and is suitable for surface-to-surface use against ships and hovercraft.

The Seawolf missile with Marconi Radar systems surveillance radar and blindfire differential tracker radar together with Vickers six-barrel launcher make up Guided Weapon System 25 (GWS 25), and is currently fitted in HMS *Broadsword*, the first Royal Navy Type 22 frigate. This class of frigate carries two trackers and two launchers, and three more Type 22s are under construction.

During firing trials, Seawolf missiles intercepted Mach 2 missile targets and 4.5in shells.

In operation, any error in the missile's course is signalled from the differential tracking radar or television to the guidance shaping unit. Coded correction signals are then passed by microwave radio command link to the missile. Seawolf is suitable for installation in frigates and larger ships. For smaller ships than the Type 22s, and to improve performance against the surface skimming missile, BAeDG have collaborated with SIGNAAL to offer a system of 6.5 tons comprising a lightweight (STIR) tracker and a lightweight power loader from below launcher. This system is known as Seawolf VM40.

Below: Seawolf missile during firing trials.

UK

by SS-11 missiles during February 1973 from near Lake Baikal to a point on the Kamchatka Peninsula.

Altogether three versions of the SS-11 have been reported, the basic version with a single warhead, a version with a more accurate re-entry vehicle, and a

version with MRV warhead. The first of these makes up the majority of operational SS-11s, while the second is not thought to be operational and at least 60 of the third type are operational, each probably carrying three 300-kiloton yield MRVs.

Serb (SS-N-5)

Underwater-to-surface or surface-to-surface missile. In service.

Powered by: Solid-propellant motors. Eighteen small gas-jets at base for ejection from launch tube

Airframe: Two-stage missile. Both stages and round-nosed re-entry vehicle are cylindrical, of progressively-reduced diameter, with tapered fairing between each. No fins or wings

Guidance and Control: Inertial guidance

Warhead: Single re-entry vehicle, warhead in megaton range

Length: 35ft 1in (10.7m)

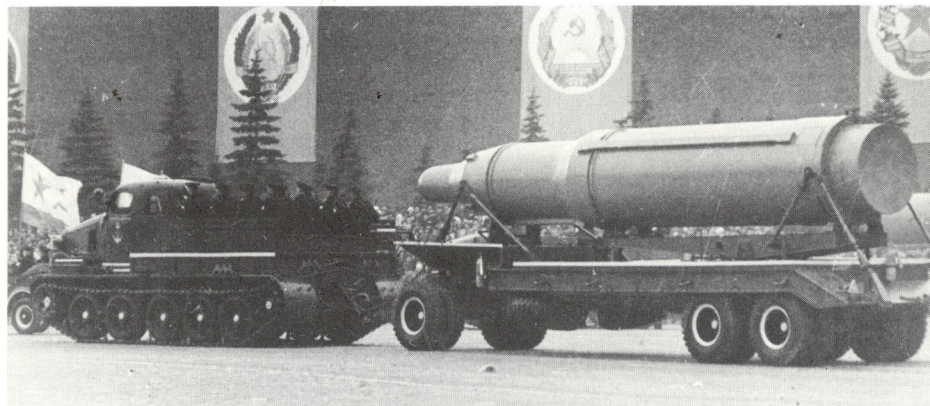
Max body diameter: 4ft 8in (1.42m)

Max range: 750 miles (1,200km)

Development and Service

This Polaris-type weapon was first shown in a Moscow parade in November 1964, suggesting that it represents an intermediate stage between the SS-N-4 'Sark' and the SS-N-6 'Sawfly'. It was described from the start as being suitable for underwater launch from Soviet submarines. After three years, in a 1967 parade, the usual cover-plate over the base was removed to reveal the nozzles for the electrically-detonated cold-gas system by which 'Serk' is ejected from its launch-tube for above-the-surface ignition of the first-stage motor.

This missile is carried by about seven Soviet 'Hotel II' class submarines, each with three tubes. It is, however, considered to be obsolescent.



USSR

Sego (SS-11)

Intercontinental ballistic missile. In service.

Powered by: Storable liquid-propellant rocket engines

Warhead: Thermonuclear, of 1-2 megaton yield, with radar decoys. Alternatively, a multiple re-entry vehicle (MRV), with three separate charges and decoys

Guidance and Control: Ground-based computers issue steering instructions by radio during powered flight phase

Max range: 6,525 miles (10,500km)

Development and Service

Little is known about the SS-11, although 1,018 of the Soviet ICBMs emplaced were of this type. It is said to have been operational in camouflaged silo launchers since 1966 and is being replaced by the SS-17 and SS-19. US monitoring services reported that two SS-11s, with warheads equivalent to a one-megaton charge, were launched 5,715 miles (9,200km) from Tyuratam test site in Kazakhstan into the Pacific on 27 and 28 July 1970. Two more SS-11s were identified at the end of 6,525 mile (10,500km) flights with MRV warheads on 21 August 1970. A further nine flights were made

USSR

Shaddock (SS-N-3) and Sepal (SSC-1B)

USSR

Surface-to-surface cruise missile. In service.

Powered by: Ramjet or turbojet cruise motor, plus two large solid-propellant JATO boosters

Airframe: Basically bullet-shape body, probably with two short-span hinged wings at mid-point and with pointed ogival nose-cone. Two jettisonable boosters under tail, to each side of large ventral fin

Guidance and Control: Command guidance.

Possible active radar homing system

Warhead: Nuclear or high-explosive

Length: 35ft 9in-42ft 8in (10.9-13m)

Max speed: Mach 0.95-1.4

Useful range: estimated 115 miles (185km)

Max range: estimated up to 520 miles (840km)

Development and Service

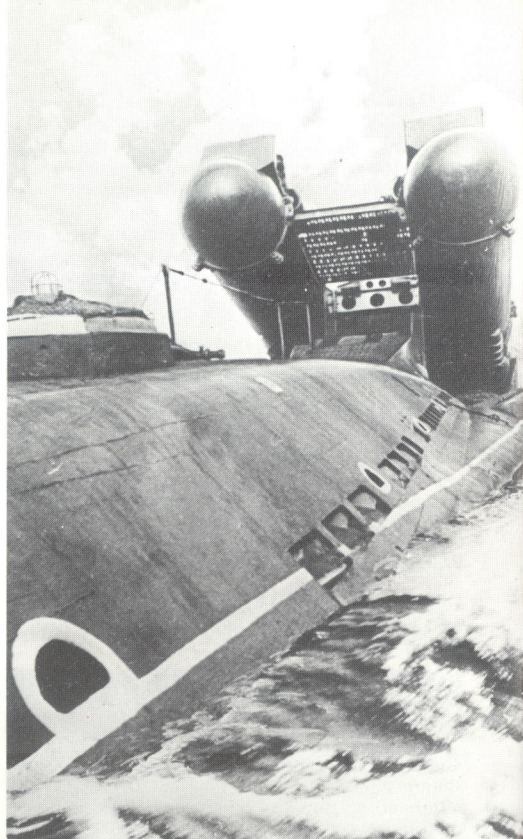
Cruise missiles of the subsonic and transonic 'flying bomb' type continue to serve in important roles in the Soviet armed forces despite the possibility that the SS-N-12 replacement is ready for operational service. The formidable 'Shaddock' is carried as a standard weapon by many surface ships and submarines. Four large destroyers known to NATO as the 'Kresta 1' class each carry four 'Shaddocks' in

two twin launch-tubes, without reload capability. This armament is more than doubled on the four destroyers of the Kynda class, each of which has four launch-tubes in a side-by-side cluster on the foredeck and four more on the after deck, almost certainly with eight more missiles in store for a second strike. Each ship carries 'Scoop Pair' radar. About 50 submarines are thought to be armed with 'Shaddock'. The nuclear-powered 'Echo II' class carries eight missiles; the 'Juliet' class carry four each; and the converted 'Whisky' class carry four in what are known as longbin containers. 'Shaddock' is also land-based in the SSC-1B 'Sepal' coastal defence weapon system, which is based on an eight-wheeled vehicle. Each 'Sepal' battalion is reported to have up to 18 missiles.

'Shaddock' has never been revealed in public and the above description is based on what can be seen through the open ends of missile containers mounted on trucks which have taken part in parades through Moscow. It is generally thought that there might be some differences between the naval and land-based Shaddocks, and that several different missiles of this type may be in naval use. The drawing is based on one which appeared in an official East German magazine, but has been modified to conform with known details of the nose and tail configuration. No details of the air intake for the cruise engine are known, but this could be annular like that of 'Ganef' (qv).

Right: 'Shaddock' missile launchers on 'Whisky' class submarine.

Below: 'Sepal' missile carrier.



Shahine

Surface-to-air missile. In production.

Prime contractor: SA Matra

Powered by: Single-stage solid-propellant rocket motor

Airframe: Similar to Crotale

Warhead: As for Crotale

Length: approx 9ft 10in (3.00m)

Body diameter: 5.9in (0.15m)

Wing span: 1ft 9.25in (0.54m)

Range: 6.5 miles (10.5km)

Development and Service

The Shahine missile system is based on Crotale and has been ordered by Saudi Arabia. Compared with the Crotale missile, the Shahine missile is a little longer because of its uprated rocket motor, which increases range, and the launcher for six missiles is mounted on an AMX30 tank chassis. The surveillance radar is also mounted on its own tracked vehicle. Up to four launch vehicles can accompany each radar vehicle, and can be associated with AMX30SA 30mm cannon anti-aircraft tanks and rocket defence weapons.

Trial firings of Shahine began in 1977 and delivery to Saudi Arabia is expected in 1980.

France

Shafir

Short-range air-to-air missile. In production and service.

Prime contractor: Rafael Armament Development Authority

Powered by: Solid-propellant rocket motor

Airframe: Cylindrical body with rounded nose and cruciform canard control surfaces indexed in line with cruciform tail-mounted wings

Guidance and Control: Infra-red seeker head. Control via canard surfaces

Warhead: High-explosive, weight 24.25lb (11kg), with impact or proximity fuse

Length: 8ft 1.5in (2.47m)

Body diameter: 6.3in (0.16m)

Wing span: 1ft 8.5in (0.52m)

Launch weight: 205lb (93kg)

Max range: 3.1 miles (5km)

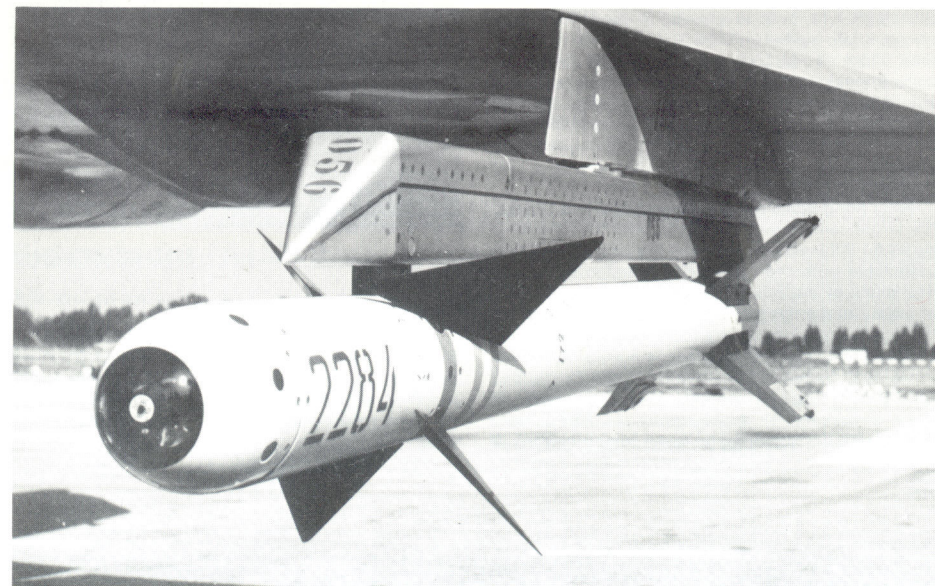
Effective ceiling: 60,000ft (18,000m)

Development and Service

Development of this missile was completed by the late 1960s, when production was started. It was designed to be used against aircraft at altitudes of up to 59,000ft (18,000m). Shafir has, since 1969, been used with considerable success in combat. During the Yom Kippur War of October 1973, a very large number of Arab aircraft were reported to have been destroyed in air combat for the loss of only a few Israeli aircraft. Of these Arab aircraft more than 100 were brought down by Shafir, representing approximately a 60% kill ratio to missiles fired.

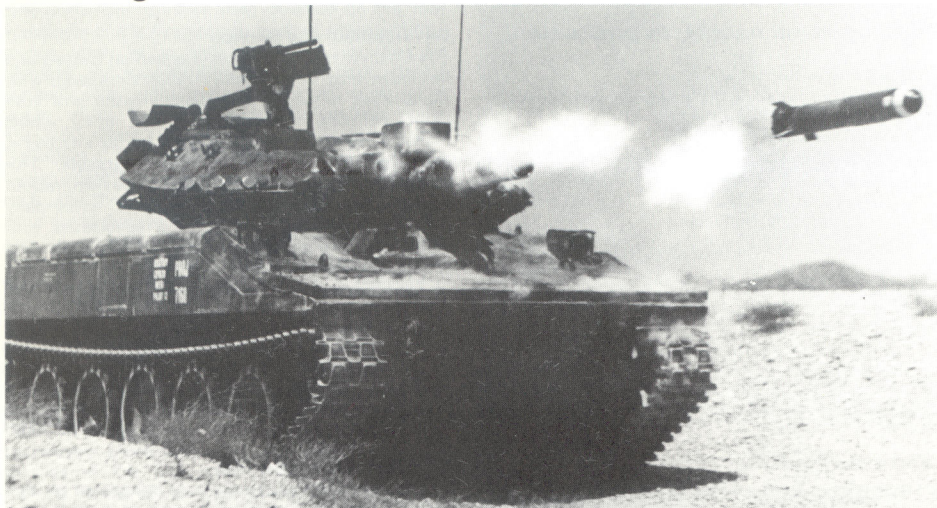
In operation, if a target is detected within the firing range, an audio signal is heard and an indicator light in the cockpit is automatically switched on. These signals indicate that the missile-launch button can be pressed. Following launch, the missile's guidance system automatically tracks the target, without further assistance from the launch aircraft. Several other countries are reported to have bought Shafir missiles, including Taiwan, Argentina, South Africa and Peru.

Israel



Shillelagh (MGM-51A)

USA



Lightweight army close-support missile. In service.

Prime contractor: Ford Aerospace and Communications Corporation, Aeronutronic Division
Powered by: Single-stage solid-propellant rocket motor

Airframe: Round-nosed cylindrical body, with four slightly swept flip-out tail-fins

Guidance and Control: Aeronutronic command guidance system, with infra-red tracking. Control by sustainer exhaust deflection

Warhead: Octol shaped-charge

Length: 3ft 9.5in (1.14m)

Body diameter: 5.95in (0.152m)

Launch weight: 59lb (26.8kg)

Range: over 17,060ft (5,200m)

Development and Service

Shillelagh was built in greater numbers than any previous US guided missile. It is unusual in being fired from a gun/launcher that can also fire conventional ammunition. This makes it an ideal weapon for tanks and other armoured fighting vehicles, and it has been carried by General Sheridan AFVs of the US Army since 1967, including extensive overseas deployment. The system is also deployed with the M60A2 battle tank.

After firing Shillelagh, the gunner has only to keep the target centred on the cross-hairs of his telescopic sight. An infra-red missile tracking/command system associated with the sight detects and corrects any deviations of the missile's flight path from the line-of-sight to the target. Shillelagh provides greatly increased fire-power for use against all types of armoured fighting vehicles, troops and fortifications. It has been tested in an air-to-surface role from a Bell UH-1B helicopter, in conjunction with a stabilised sight developed by Aeronutronic. In 1975 tests began with an experimental laser-guided version of



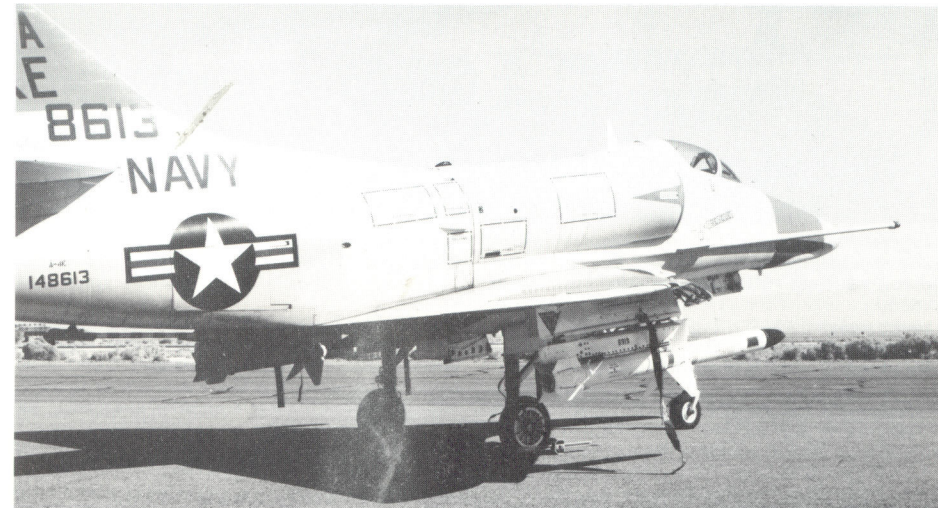
Top: Shillelagh launch from a General Sheridan AFV.

Above: Shillelagh missile.

Shillelagh, and in the following year a Sheridan reconnaissance vehicle and an M60A2 tank were modified for further tests. This version of the missile has been referred to as Shillelagh LBR or Laser Beam Rider.

Shrike (AGM-45A)

USA



Supersonic air-to-surface anti-radar missile. In production and service.

Prime contractor: Naval Weapons Center, China Lake, California

Powered by: Rocketdyne Mk 39 Mod 7 or Aerojet Mk 53 solid-propellant rocket motor

Airframe: Slim cylindrical body with ogival nose. Pivoted cruciform wings mid-way from nose to tail, indexed in line with cruciform tail-fins

Guidance and Control: Passive homing head by Texas Instruments/Sperry Univac. Control via pivoting wings

Warhead: High-explosive fragmentation type, with proximity fuse; weight 145lb (66kg)

Length: 10ft 0in (3.05m)

Body diameter: 8in (0.20m)

Wing span: 3ft 0in (0.91m)

Launch weight: 400lb (182kg)

Performance: Secret, but cruising speed is supersonic and range is thought to be about three miles (5km)

Development and Service

Shrike was developed initially under the acronym ARM (anti-radar missile), to home on enemy radars.

Above: Shrike under the wing of a Skyhawk.

The need for such a weapon was underlined by the war in Vietnam, where it became increasingly important for the Americans to knock out or jam the North's warning and missile/aircraft guidance radars during the US air offensive. Delivery to US Navy carrier-based attack squadrons began in 1964. Shrike can arm all Navy attack aircraft and most F-4 and the F-105G aircraft of the USAF; it was used widely in Vietnam from 1965. Production for the USAF was planned to continue in fiscal year 1978 (the US Navy completing their purchase in FY 1974), and many improvements have been introduced through the years to increase the weapon's effectiveness, leading to a series of 12 versions designated between AGM-45-1 and AGM-45-10, which differ primarily in the frequency coverage of the detachable seeker sections.

The US Navy acquired a total of 11,167 Shrikes between 1965 and 1975. Production continues for the USAF, which purchased 9,638 by FY 1974, with projected procurements to FY 1978 totalling another 3,763 missiles, many of the late models as armament for F-4G 'Wild Weasel' defence suppression squadrons.

Sidewinder (AIM-9)

USA

Air-to-air missile. In production and service.

Data: AIM-9B and AIM-9H/L

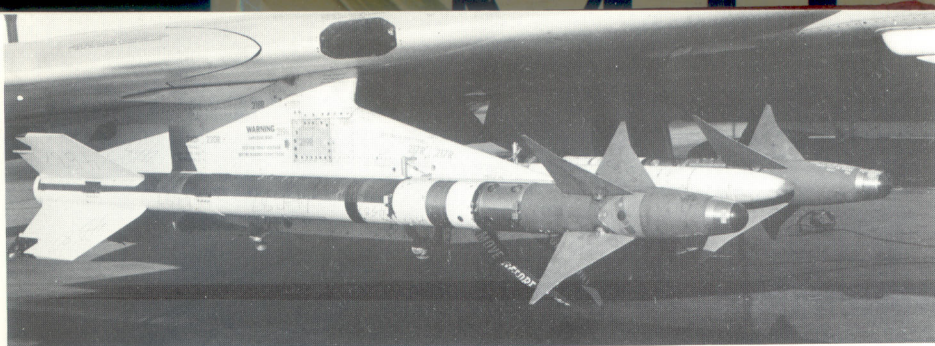
Prime contractor: US Naval Weapons Center, China Lake, California

Powered by: Naval Propellant Plant solid-propellant rocket motor

Airframe: Slim cylindrical aluminium body, with hemispherical glass nose. Delta-shape cruciform control surfaces at nose, indexed in line with large cruciform tail-fins

Guidance and Control: Infra-red homing guidance. Control by cruciform foreplanes

Warhead: High-explosive, weighing 25lb (11.4kg)



Length: 9ft 3.5in (2.83m) 9ft 5in (2.87m)
Body diameter: 5in (0.13m)
Span of tail-fins: 1ft 10in (0.56m) 2ft 0.75in (0.63m)
Launch weight: 159lb (72kg) 190lb (86kg)
Max speed: Mach 2.5
Max range: 2 miles (3.35km) 4.35 miles (7km)

Development and Service

Sidewinder is one of the most-produced of all airborne missiles. Firing trials began on 11 September 1953, and more than 80,000 of the basic infra-red homing AIM-9Bs were manufactured subsequently by Ford Aerospace and General Electric for the US services, the Royal Navy, Royal Canadian Navy, Royal Netherlands Navy, the Air Forces of nine NATO nations, Australia, Japan, the Philippines, Spain, Sweden, Taiwan and other countries. In addition, some 9,000 were produced under licence in Europe, by Bodenseewerk of Germany in association with companies in Denmark, Greece, the Netherlands, Norway, Portugal and Turkey.

The popularity of the initial Sidewinder resulted from the fact that it had fewer than two dozen moving parts and no more electronic components than the average home radio. A unique version of the Sidewinder family was the AIM-9C in that it had a Motorola semi-active radar guidance system to make it compatible with the all-weather combat capability of late-model F-8 Crusader fighters of the US Navy. All other Sidewinders employ infra-red guidance. The AIM-9D, produced mainly by Raytheon for the US Navy and UK, introduced a Rocketdyne Mk 36 Mod 5 motor for increased speed and range, a new guidance unit and warhead, and could be distinguished by its tapering nose and larger-chord canards. These components were common to the

Above: Sidewinder AIM-9L on a US Navy F-4 Phantom II.

AIM-9C. The AIM-9E, produced by Ford Aerospace for the USAF, was a converted B with improved guidance and control. Approximately 5,000 were produced. Raytheon's AIM-9G was similar to the D but with improved target acquisition and lock on, for the US services. To overcome limitations experienced in Vietnam, the US Navy's AIM-9H, in production since 1971, is a development of the G for 'dogfighting', with solid-state guidance for improved reliability decreased minimum effective range and faster angle-tracking rates.

The AIM-9J, produced by Ford Aerospace for the USAF, incorporates improved manoeuvring ability. A later version of AIM-9J, designated AIM-9P, includes improved lethality due to improved fusing and a reduced smoke rocket motor. AIM-9N is the designation of the FMS version of AIM-9P. The AIM-9L, a joint US Navy and US Air Force developed Sidewinder produced by Raytheon and Ford Aerospace, features improved manoeuvrability, increased acquisition envelope, and increased lethality due to fuse and warhead improvements. Under development by Ford Aerospace for proposed use by the USAF is the AIM-9J+ (J-3) incorporating solid-state electronics, improved fusing and increased acquisition envelope. Under joint development by the US Navy and USAF is the AIM-9M with improved capabilities which include increased counter-countermeasures, improved background discrimination and closed cycle cryogenics. Reliability and value engineering improvements are also proposed and a reduced smoke rocket motor is in development.

Siren (SS-N-9)

Surface-to-surface missile. In service.

Guidance and Control: Autopilot with possible radio command. Active radar terminal homing
Warhead: High-explosive
Range: 46-170 miles (75-275km)

Development and Service

The SS-N-9 is carried by the Nanuchka class corvettes, each having a triple launcher on each side of the bridge. Deployment began in about 1968.

USSR

Skean (SS-5)

Intermediate-range ballistic missile. In service.

Powered by: Liquid-propellant rocket motor

Airframe: Cylindrical body of constant basic

diameter, with flared skirt at tail and blunted conical nose-cone. No fins or wings

Guidance and Control: Probably inertial

Warhead: Thermonuclear 1 megaton yield

Length: 75ft 0in (23.0m)

Max body diameter: 8ft 0in (2.40m)

Max range: 2,300 miles (3,700km)

Development and Service

Although infinitely more formidable than V-2, 'Skean' can probably be regarded as the ultimate

USSR

postwar development of the basic concept of that wartime German missile. It appears to be a scale-up of the 'Shyster-Sandal' family, with storable liquid-propellant rocket engine, and has a thermonuclear warhead of one megaton yield.

'Skean' was first deployed in 1961 and was included in a parade through Moscow in November 1964. Subsequently Soviet films showed missiles of this type housed in underground silo launchers, but deployment seems to have been limited, with no more than 100 'Skeans' operational. Like 'Sandal', these were probably divided between Russia's missile forces aimed at Western Europe and China and Japan. Many 'Skeans' have already been replaced by SS-20s, and it is expected that all 'Skeans' will be superseded shortly.



Sky Flash

UK

Sky Flash missiles carried by a Swedish Air Force JA 37 Viggen.

